UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

TO: Addressees

FROM: Frank Ciavattieri

SUBJ: Revised Project Schedule

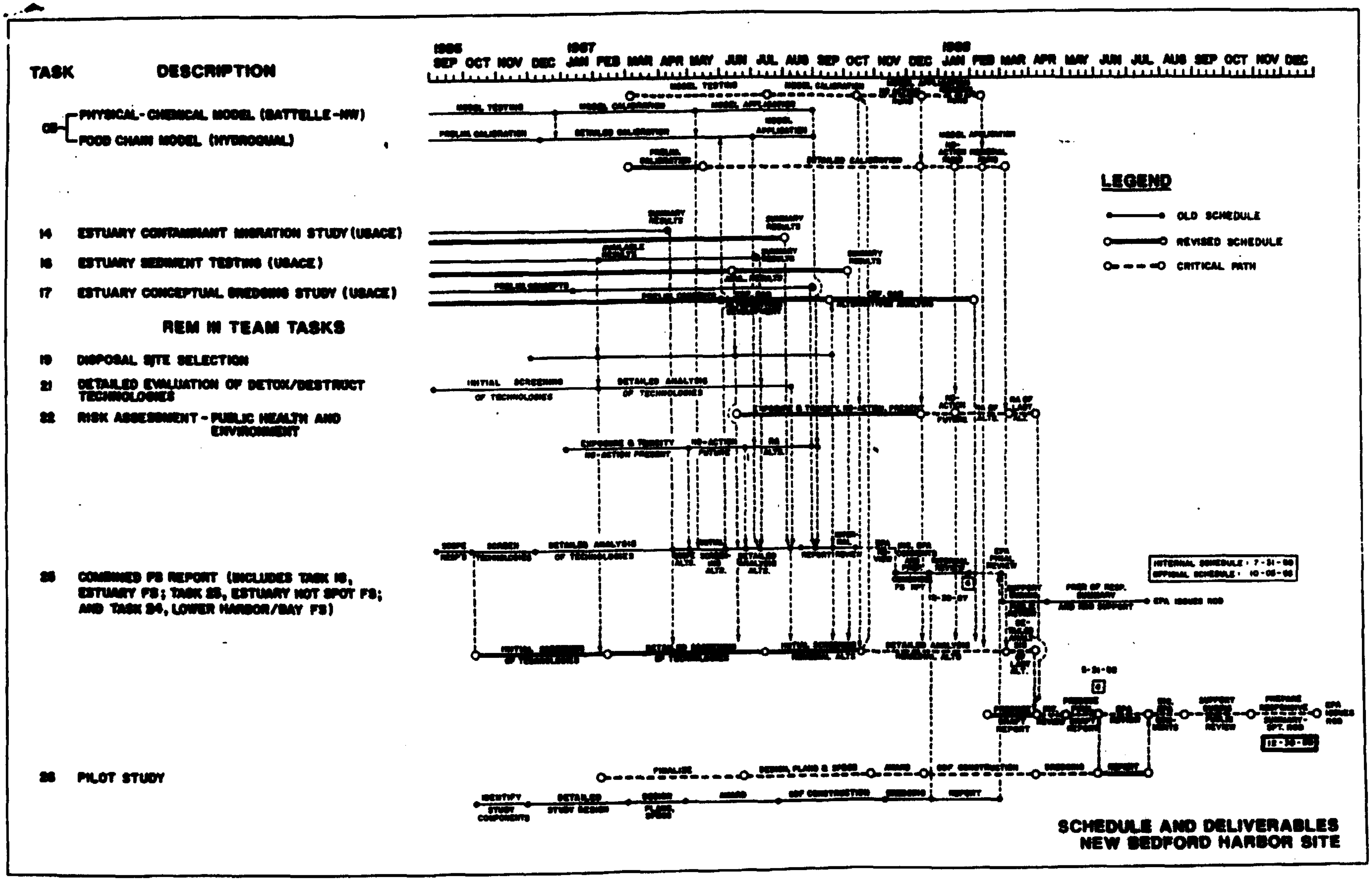
DATE: July 16, 1987

Attached hereto is a PERT Chart showing the original and revised project schedule for the New Bedford Harbor Site. Only major tasks are shown with critical path activites identified.

The revised schedule reflects the addition of the pilot dredging and disposal study. It also reflects time lost in completing PCB analysis necessary to feed into the Battelle hydrodynamic and food chain model.

It should be noted, however, that the new schedule is consistent with dates presented at the April public meeting in New Bedford.

Further discussion on the project schedule will be held at our next monthly progress meeting on July 23, 1987 at 9:00AM in Room 1900-A of the JFK Federal Building.



SCHEDULE AND DELIVERABLES
NEW BEDFORD HARBOR SITE

EPA WORK ASSIGNMENT NUMBER: 04-1L43.1

EPA CONTRACT NUMBER: 68-01-7250

EBASCO SERVICES INCORPORATED

REQUEST FOR PROPOSAL FOR BENCH SCALE TESTING OF BIODEGRADATION TECHNOLOGIES FOR PCBS IN NEW BEDFORD HARBOR SEDIMENT

NEW BEDFORD HARBOR
FEASIBILITY STUDY
MAY 1987

Prepared by:

EBASCO SERVICES, INC.
and
E.C. JORDAN CO.

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1.0 INTRODUCTION

1.1 REQUEST FOR PROPOSAL

Ebasco Services Inc. (EBASCO), under contract to the U.S. Environmental Protection Agency (USEPA) is soliciting proposals for bench scale testing to demonstrate performance of biodegradation technologies to detoxify polychlorinated biphenyl (PCB) contaminated sediments from New Bedford Harbor, New Bedford, Massachusetts.

The scope of work for bench scale testing includes:

1) preparation of project plans, including a bench scale testing plan and a quality assurance project plan;

2) implementation of the bench scale testing, including sampling requirements detailed in the bench scale testing plan;

3) disposal of treated sediments and treatment residues at appropriate facilities in accordance with applicable federal and state requirements; and

4) preparation of a final report.

1.2 BACKGROUND INFORMATION

PCB contamination in New Bedford Harbor was documented by both academic researchers and the Federal Government as early as 1974. The area north of the Hurricane Barrier, consisting of 985 acres, is known to be underlain by sediments containing elevated levels of PCBs and heavy metals. PCB concentrations range from no detection to over 30,000 ppm. Metals (i.e., cadmium, chromium, copper, and lead) concentrations range from no detection to above 5,000 ppm (removal of metals is not required during bench testing).

The sediments in the harbor vary from predominantly organic silts in the upper estuary, where the higher levels of PCB and metals contamination exist, to predominantly silty sands in the Lower Harbor/Bay area. Estimated volumes of contaminated sediment are presented in Table 1. Information relative to the physical properties of the sediments are presented in Table 2. More detailed information on site characteristics is available from EBASCO.

EBASCO is under contract to USEPA to perform a Remedial Investigation/Feasibility Study (RI/FS) on the New Bedford Harbor Site (Figure 1), to assess the PCB and metals contamination at the site and to evaluate alternatives for remedial action. Task 21 of the RI/FS Work Plan is a detailed evaluation of detoxification/destruction technologies available to treat the contaminated sediments. A major part of this task is to perform treatability studies (bench tests) using biotechnologies which have been identified as potentially effective for use in decontaminating sediments.

2.0 OBJECTIVES

The objectives of the bench scale testing program are to:

- evaluate the potential applicability of a proposed biotechnology, to significantly reduce, immobilize, or detoxify/destroy PCBs in New Bedford Harbor sediments;
- evaluate the effects of high levels of metal concentrations on the proposed technology; and
- identify whether the technology should be evaluated further in an on-site pilot scale application.

Three areas for which information is needed are:

15 days to respond
5 days you intend to respond

$70,000 anticipated amount [illegible] [illegible]

EPA WORK ASSIGNMENT NUMBER: 04-1L43.1

EPA CONTRACT NUMBER: 68-01-7250

EBASCO SERVICES INCORPORATED

REQUEST FOR PROPOSALS FOR BENCH TESTING OF SELECTED TECHNOLOGIES FOR PCB DETOXIFICATION/DESTRUCTION

NEW BEDFORD HARBOR FEASIBILITY STUDY
MAY 1987

Prepared by:

EBASCO SERVICES, INC.
and
E.C. JORDAN CO.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 REQUEST FOR PROPOSALS

Ebasco Services, Inc. (EBASCO), under contract to the U.S. Environmental Protection Agency (USEPA), is soliciting proposals for treatability studies (bench tests) for destruction and/or detoxification of polychlorinated biphenyls (PCBs) in New Bedford Harbor sediments.

Proposals are requested on treatment technologies that EBASCO has selected for evaluation for potential use at New Bedford Harbor and for which additional information is needed. EBASCO is requesting proposals for bench testing of the following technologies:

- potassium/polyethylene glycol dechlorination (KPEG);
- solvent extraction;
- supercritical extraction;
- vitrification; and
- supercritical water oxidation.

General descriptions of these technologies are presented in Section 6.0.

The purpose of the bench testing is to gather information on treatment technologies to determine their applicability to the site-specific New Bedford Harbor sediments. There are three areas for which information is needed:

- Effectiveness. Information is needed to evaluate the effectiveness of a technology in detoxifying/destroying the PCBs in the New Bedford Harbor sediments. Treatment goals for New Bedford Harbor have not been established. Possible goals for the treatment of the sediment are to reduce the PCB concentrations in the treated sediments to 50 ppm, 10 ppm, 1 ppm, or 0.1 ppm. Information relative to the ability of, and costs or time for, a treatment process to treat the sediments to these various levels is required where applicable. If treatment to these levels is not achievable, information relative to the level to which the PCB-contaminated sediment can be treated is needed. The bench testing should also provide information relative to potential air or water effluents from the treatment technology, or harmful by-products generated during the treatment of the sediments.

Information relative to metals removal/encapsulation by a treatment technology is also sought where applicable.

- Acceptable Engineering Practices. A technology must be feasible for the location and conditions of the site and, in the case of New Bedford Harbor, must be capable of treating large volumes of sediments, potentially between 10,000 and 1,000,000 cubic yards. The operational reliability of the technology and the difficulty in construction and implementation will be evaluated. Availability of equipment will also be considered. Data from the bench testing will be used during the design of a remedial action for New Bedford Harbor.

- Cost. Cost data is needed for EBASCO to estimate implementation costs including mobilization, site preparation, equipment, capital costs, operation and maintenance costs, demobilization, closure, and disposal of residuals.

EBASCO intends, upon receipt and favorable review of cost-effective proposals, to award one contract for testing each of the five technologies. Bidders are encouraged to address one or more technologies which they consider to be within the relevant scope of their expertise. A successful bidder may receive one or more awards. In the event that the bidder proposes on two or more technologies, his bid must be clearly separable technically and by cost for the technologies on which he has proposed. EBASCO reserves the right to make limited or no awards under this inquiry.

1.2 BACKGROUND

EBASCO is under contract to the USEPA to perform a Remedial Investigation/Feasibility Study (RI/FS) on the New Bedford Harbor site (Figure 1) to assess the PCB and metals contamination at the site and to evaluate alternatives for remedial action. Task 21 of the RI/FS Work Plan is a detailed evaluation of detoxification/destruction technologies available to treat the contaminated sediments. A major part of this task is to perform treatability studies (bench tests) using technologies which have potential for use in decontaminating the sediments.

PCB contamination in New Bedford Harbor was documented by both academic researchers and the federal government as early as 1974. The entire area north of the Hurricane Barrier, consisting of 985 acres, is underlain by sediments containing elevated levels of PCBs and heavy metals. PCB concentrations

EPA/540/G-85/002
June 1985

Guidance on Remedial Investigations Under CERCLA

Prepared for:

Hazardous Waste Engineering Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

and

Office of Emergency and Remedial Response
and
Office of Waste Programs Enforcement
Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, D.C. 20460

CHAPTER 8

BENCH AND PILOT STUDIES

8.1 INTRODUCTION

Bench and pilot studies may be needed to obtain enough data to select and implement a remedial action alternative. Justification for these studies is found in section 300.68 of the National Contingency Plan (NCP). This chapter addresses ways bench and pilot studies are used in remedial investigations and presents guidance for:

- Determining the need for bench and pilot studies based on the site/waste characteristics or technology
- Developing a test plan by defining the goals and level of study needed
- Interpreting and applying data developed during the study.

Hazardous waste site remediation programs have challenged technologies in two principal ways. First, both traditional and emerging technologies from many different disciplines are being applied on an accelerated and often overlapping basis. Technologies from the materials and soils science fields, critical to the containment strategies being used, evolved in relatively clean environments. As a result, there is little information about technology performance in a contaminated environment (i.e., how a synthetic or clay liner will behave at a waste site). Second, the treatment technologies developed for industrial wastes depend on an aqueous environment to facilitate the transfer and conversion of pollutants and removal of byproducts. In the typical remedial problem, mass transfer is usually a critical or rate limiting factor.

Almost without exception, the following conditions will apply in a hazardous site remediation project:

- The physical matrix in which a technology must work is heterogeneous; that is, solid, slurry, aqueous, or gaseous environments can exist all within a given setting.

- The hazardous constituents are (usually) as heterogeneous as the matrix.

As a result of these circumstances, the transferability of a technology is limited not only by the discipline or science in which the technology originated but also from one hazardous waste site to the next. All too often the limits of technology transferability have been ignored or inadequately considered, and the penalties have been expensive; liner failures, ineffective treatment systems, and underground gas migration are frequent examples. Bench and pilot studies are alternatives to haphazard transfer of technology from one application to another (with attendant risks of time, dollar, and resource losses).

8.2 OVERVIEW OF BENCH AND PILOT STUDIES

As shown in Figures 1-2 and 8-1 (RI/FS process diagrams), bench and pilot studies, if needed to support remedial alternatives development and feasibility analyses, are conducted as part of the remedial investigation task sequence. However, bench and pilot studies may also be conducted for design and construction of the selected alternative and are outside the scope of RI/FS activities. In general, bench-scale studies are appropriate for the remedial investigation stage, while pilot-scale studies, if required, may be conducted during the final design. The scope of bench and pilot activities during the RI is generally limited to treatability and materials testing activities to help identify, screen, and evaluate FS alternatives.

During the initial tasks of the FS, treatment alternatives are developed and then screened later in the process. Information from these tasks and the analysis of information from the site investigation are used to identify information gaps and to establish the need for bench and pilot studies. An appropriate experimental plan is then developed and documented in a Statement of Work (SOW). The results are used in the technical analysis for screening and analyzing remedial alternatives in the feasibility study as well as developing the design for the selected alternative.

8.2.1 Difference between Bench and Pilot Studies

Bench studies differ from pilot studies in purpose, size, cost, application, and other factors, which are summarized in Table 8-1. Their purpose is to determine the feasibility of an application over the range of conditions expected. Bench-scale studies are flexible in that a wide range of variables can be evaluated in determining the performance capabilities and limitations of a technology.

Pilot studies may be used in the RI to guide the selection of an alternative when the choice cannot be made from bench-scale data, or they may

Figure 8-1. Bench/Pilot Study Logic Diagram

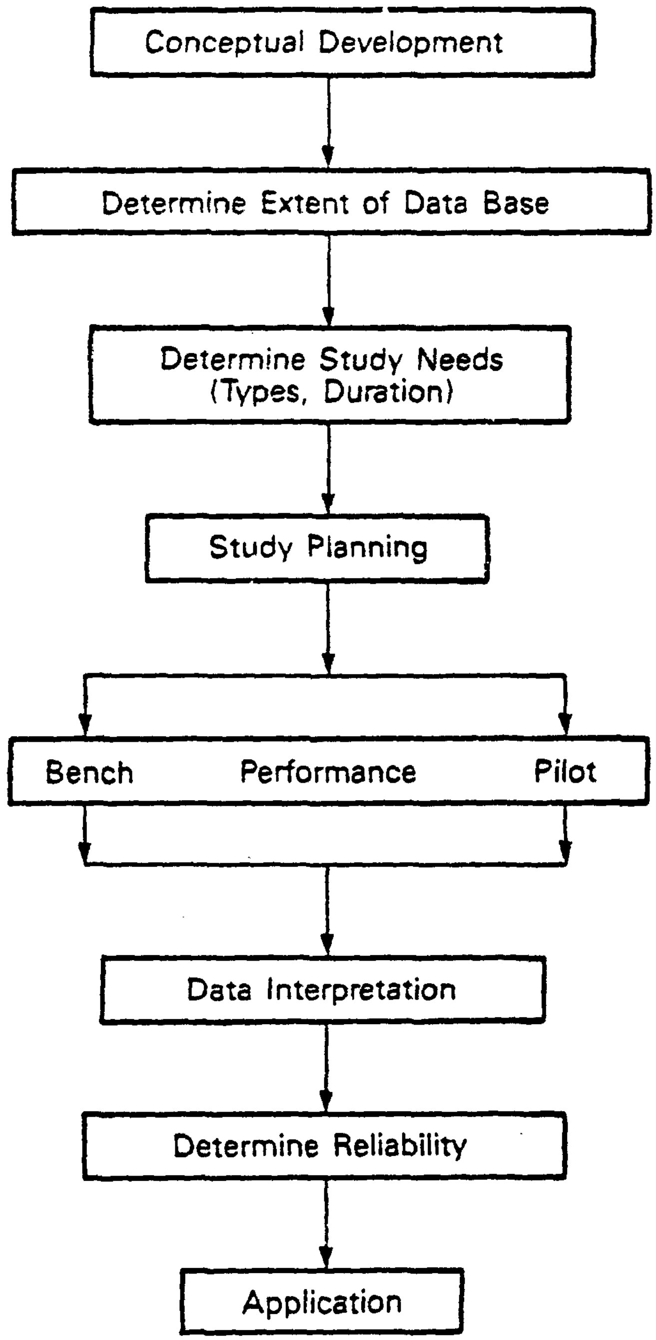

TABLE 8-1. BENCH AND PILOT STUDY PARAMETERS

Parameter	Bench	Pilot
Purpose	Define process kinetics, material compatibility, impact of environmental factors, types and doses of chemicals, active mechanisms, etc.	Define design and operation criteria, materials of construction, ease of material handling and construction, etc.
Size	Laboratory or bench top	1-100% of full-scale
Quantity of Waste and Materials Required	Limited amounts	Large amounts
Number of Variables That Can Be Considered	Many	Few
Time Requirements	Days to months	Months to years
Typical Cost Range	0.5-2% of capital costs	2-5% of capital costs
Most Frequent Location	Laboratory	On-site
Limiting Considerations	Wall and boundary effects; volume effects; solids processing difficult to simulate	Limited number of variables; waste volume required; safety, health, and other risks

be used outside the RI/FS process to define the design and operating criteria and specific features of a selected alternative. Pilot studies are also useful in determining the stability of a process or material in an application and are aimed at delineating specific design and operating criteria. These studies are much larger than bench studies in scale, cost, time, and waste volume required.

8.2.2 Approach

The specific need for bench and pilot studies may be identified during the RI/FS process or during remedial alternative design. The need is defined from an assessment of what is known and what is required to establish the feasibility of applying a technology. The level of development of the technology should be considered (has the process, technique or material been studied or used previously, and if so with what results?). The characteristics of the liquid, slurry, or solid wastes and the site itself should be factored into the decision. The cost savings expected from minimizing the risk of failure at full scale should also be quantified and considered in the decision.

The scope of bench and pilot studies is also an iterative process that progresses through the development of the FS and selected remedial alternative design and construction. Bench and pilot studies conducted in the RI may range from limited treatability (bench) studies to screen general technology types in the FS, to pilot studies to fully evaluate particular alternatives to the FS. In the design and construction stages, full scale pilot studies may also be conducted to determine design and operating standards for the remedial alternative selected in the RI/FS process. The EPA Remedial Project Manager must decide the scope and phasing of bench and pilot studies.

A formal process for defining and conducting treatability studies is presented in the logic diagram of Figure 8-1. The initial step consists of specifying the concept to the extent possible, using available information on how the process or material works over the expected range of application conditions and the factors governing or limiting the application. This specification should be based on a literature review, vendor contacts, and past experience. The next step consists of determining the type and specific goals of the study and the level of effort needed. Once these factors are determined, a complete test plan or SOW is prepared, which contains all information needed to perform the study including data management and interpretation guidelines. The tests are then conducted, and the results are tested for reliability and interpreted. Additional testing may be needed after the data are interpreted, necessitating reevaluation of the SOW and additional study, particularly if the application is innovative.

8.2.3 Example Testing Programs

Table 8-2 illustrates the diversity of activities that may be required to select and apply a remedial technology. The examples of bench and pilot test programs illustrate the diverse disciplines and sciences required to define application conditions for the technologies identified in section 300.70 of the NCP.

8.2.4 Cost Considerations

When deciding the type and extent of studies, cost can be a limiting factor. Pilot-scale studies are significantly more expensive than bench-scale studies, and continuous testing is more expensive than batch testing. As shown in Table 8-1, bench-scale testing may cost 0.5 to 2 percent of the capital cost of an alternative, while pilot-scale studies may require 2 to 5 percent of the capital cost. However, if the capital cost is low (e.g., $100,000 or less), the cost for pilot testing will probably be greater than 5 percent. Therefore, the cost of an extensive testing effort must be weighed carefully in relation to the cost of applying the technology.

8.3 BENCH-SCALE STUDIES

Once the need for a bench-scale study is established, an experimental plan or Statement of Work must be developed. The specific study objectives and the necessary level of detail should be carefully defined. The flexibility and limitations of bench-scale studies must also be considered in the preparation of a test plan.

8.3.1 Preplanning Information Needs

Certain information is required before the planning of a bench-scale study. A waste and site characterization must be completed, preliminary remedial technologies identified, and then information on the alternatives obtained. This information is then used to screen the alternatives and to ascertain if the proposed application is so different from prior applications that process feasibility, efficiency, or material stability cannot be predicted. If this is the case, bench or pilot studies or both are required for the technical analysis portion of the screening procedure.

TABLE 8-2. EXAMPLES OF BENCH AND PILOT SCALE TESTING PROGRAMS

Remedial Technology	Example Testing Programs
A. Air Pollution and Gas Migration Control 1. Capping 2. Dust Control 3. Vapor Collection and Treatment (carbon adsorption)	Bench: Soil density and bearing capacity vs. moisture content curves for proposed capping materials. Pilot: In-place soil densities; determination of gas withdrawal rates to control releases.
B. Surface Water Controls 1. Capping 2. Grading 3. Revegetation 4. Diversion and Collection	Bench: Column testing of capping material compatibility with wastes present. Pilot: In-place testing of geotextiles for control of erosion in grassed diversion ditches.
C. Leachate and Ground-Water Controls 1. Containment barriers (slurry walls, grout curtains, etc.) 2. Ground-water pumping (well points, suction wells, etc.) 3. Subsurface collection drains 4. Permeable treatment beds (limestone, activated carbon) 5. Capping	Bench: Determination of basicity and headloss vs. grain size of limestone materials for a treatment bed. Determination of chemical compatibility of a compacted clay with a leachate stream. Pilot: In-place testing of a soil type and grain size specification and tile drain configuration for a subsurface collection drain.
D. Direct Waste Control 1. Incineration 2. Solidification 3. Biological Treatment • Activated sludge • Facultative lagoons • Trickling filters 4. Chemical Treatment • Oxidation/reduction • Precipitation • Neutralization • Ion exchange resins	Bench: Characterization of chemical and heat content of hazardous waste mixes; chemical, physical, and biological treatability studies to define rate constants, minimal-maximal loading rates and retention times, optimal pH and temperature, sludge generation rates and characteristics, and oxygen transfer characteristics; chemical type and dose rates; solids flux rate vs. solids concentration in sludge

(continued)

TABLE 8-2. (continued)

Remedial Technology	Example Testing Programs
5. Physical Treatment • Carbon adsorption • Flocculation • Sedimentation • Membrane processes • Dissolved air flotation • Air stripping • Wet air oxidation 6. In-Situ Treatment • Microbial degradation • Neutralization/detoxification • Precipitation • Nitrification 7. Land Disposal (landfill, land application)	thickening systems; air/volume ratios for stripping towers. Pilot: Test burns to determine retention time, combustion chamber and after-burner temperatures, and and fuel makeup requirements for the incineration of a waste. Endurance/performance tests on membranes in reverse osmosis units for ground-water treatment. In-situ microbial degradation testing of nutrient dose and aeration rates to support in-place degradation of contaminants in a plume from an underground leak. Evaluation of in-place mixing procedures for the solidification of a sludge in a lagoon.
E. Soil and Sediment Containment and Removal 1. Excavation 2. Dredging 3. Grading 4. Capping 5. Revegetation	Bench: Determination of soil adsorptive (cation exchange capacity) properties and chemical composition. Pilot: Small-scale dredging to assess sediment resuspension or production rates.

8.3.2 Specification of Objectives and Level of Detail

The objectives of a bench-scale project must be clearly understood from the beginning. Once the objectives of the study are established, the results of the work should be anticipated in selecting the level of study detail. Describing the expected results is essential to defining the variables to be investigated and the range of values for these variables.

Because of the relatively small scale and cost of bench-scale testing, many variables can be evaluated. However, to minimize the testing and to ensure that the work is relevant, the number of variables and range of values tested should be limited so that only those conditions that are anticipated in a full-scale application are evaluated. The impact of each individual variable on technology performance should be evaluated carefully as the final basis for deciding what variables are tested.

8.3.3 Limitations

Bench-scale investigations are flexible, allowing many variables to be evaluated, but certain parameters cannot be tested at the bench-scale level. For example, laboratory equipment simply cannot be configured to resemble the full-scale process. Although certain chemical, biological, and physical reactions may not depend directly on the size and configuration of the reactor, the rates do depend on considerations such as mass, heat, and/or energy transfer, which in turn are affected by the size and configuration. The shortened time scale of bench studies may also be a limitation because the performance capabilities of many technologies cannot be demonstrated without long exposure periods. As a result of these limitations, there are certain technologies for which only pilot-scale testing can be used to develop the information needed to select and define an alternative.

8.3.4 Statement of Work

The experimental plan is documented in a SOW. The SOW should include a clearly defined set of objectives, a detailed work plan by task, a schedule of completion, and a labor-cost estimate. The SOW should also describe or reference all experimental and analytical procedures required, a data management plan, a QA/QC plan, and a health and safety plan.

8.4 PILOT-SCALE STUDIES

Pilot-scale studies generally specify design and operating criteria for the full-scale application after the remedial action alternative has been